APPENDIX A. COMMERCIAL TECHNOLOGIES THAT ARE NOT CONSIDERED IN THE ENGINEERING ANALYSIS

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APPENDIX A. COMMERCIAL TECHNOLOGIES THAT ARE NOT CONSIDERED IN THE ENGINEERING ANALYSIS

A.1 INTRODUCTION

For the commercial unitary equipment covered under this rulemaking, there are several commercial technologies or design options that can enhance the total system energy efficiency and reduce the annual energy use of the equipment, but have no effect on the energy efficiency ratio (EER) or, in some cases, may degrade EER. For this reason, they are not considered further in the engineering analysis.

A.2 COMMERCIAL TECHNOLOGIES THAT DO NOT IMPACT EER, BUT REDUCE ANNUAL ENERGY USE

There are a wide variety of technologies available in the marketplace, which typically have no impact on the EER (nominal full load) rating, but which may improve annual energy performance. For example, multiple speed supply fans can reduce the fan power consumption of the system under partial cooling loads, but they operate at full speed under nominal design conditions using the same power requirements as a single speed fan. Technologies within this category are:

- Multiple Compressors,
- Compressor Cylinder Staging,
- Thermal Expansion Valves (TXV),
- Electronic Expansion Valves (EXV),
- High-Pressure-Side Solenoid Valve and Discharge Line Check-Valve,
- Double-Skin, High-Albedo Cabinets,
- Demand-Controlled Ventilation (DCV) Strategy,
- Economizer,
- Thermal Energy Storage,
- Multiple-Speed Supply Fans, and
- Multiple-Speed Condenser Fans.

A.2.1 Multiple Compressors

Multiple compressors are the norm in commercial unitary air conditioning equipment subject to the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)/Illuminating Engineering Society of North America (IESNA) Standard 90.1-1999 efficiency levels. Multiple compressors are also the norm in commercial unitary air conditioning equipment covered by the older Energy Policy and Conservation Act (EPCA) efficiency levels. A review of 90,000 Btu/h and larger air-cooled unitary air conditioners and heat pump systems showed few models using a single compressor. This appears to be the result of lower cost/Btu of compressor capacity for smaller, fully hermetic compressors. Smaller compressors have had larger sales volumes because they can also be used in residential size equipment and are less expensive to manufacture than their open or semi-hermetic counterparts. The use of multiple compressors also provides for multiple stages of capacity which improves part-load performance. There is a wide choice of compressor types in currently available equipment. Commercial unitary air conditioning equipment with an efficiency below the ASHRAE/IESNA Standard 90.1-1999 levels commonly uses either reciprocating or scroll compressors. However, scroll compressors currently dominate the market for equipment that meets or exceeds the ASHRAE/IESNA Standard 90.1-1999 efficiency levels. This is true for the types of commercial unitary air conditioning equipment and capacity ranges covered by this rulemaking.

The Department found that certain commercial unitary air-cooled air conditioners and air-source heat pumps already incorporate multiple-compressor designs, including scroll compressors. The Department understands that multiple compressor technology is a feature that can improve annual energy performance. However, because the EPCA energy descriptor for commercial unitary air-cooled air conditioners and air-source heat pumps is in terms of EER and multiple compressors as a design option do not impact EER, they are not viable for consideration in the engineering analysis.

A.2.2 Compressor Cylinder Staging

Compressor cylinder staging has an advantage under part-load conditions because the cooling capacity of the unit more closely matches the load and avoids excessive on-off cycling of the compressor. There are various ways to achieve compressor cylinder staging. For example, semi-hermetic compressors typically use cylinder unloaders to close internal passageways of the compressor to prevent compression within the controlled cylinder. This reduces the flow of refrigerant, system cooling capacity, and energy consumption by the compressor motor. For example, certain fully hermetic compressors designed with twin cylinders accomplish cylinder staging by reversing the rotation of the compressor motor. Rotation in one direction affects compressor operation in the twin cylinder mode, while rotation in the opposite direction disengages one of the cylinders.

For equipment within the subject capacity range, semi-hermetic compressors are atypical due to high manufacturing costs as compared to fully hermetic compressors, which are less material- and labor-intensive and lighter in weight.

The Department found that certain commercial unitary air-cooled air conditioners and air-source heat pumps already incorporate cylinder staging technology. The Department understands that compressor cylinder staging is a feature that can improve annual energy performance. However, because the EPCA energy descriptor for commercial unitary air-cooled air conditioners and air-source heat pumps is in terms of EER, and compressor cylinder staging as a design option does not impact EER, it is not viable for consideration in the engineering analysis.

A.2.3 Thermal Expansion Valves

The use of mechanical TXVs, as opposed to fixed orifice type expansion devices, likely has no EER benefit in a properly designed and charged air conditioning system. However, TXVs will typically allow better control of the refrigerant at part-load or at off-design operating conditions. There are other benefits that may result in better field performance. Experience with residential split air conditioning systems suggests that 62 percent of the units are improperly charged in the field.[1] While this can significantly degrade performance in the field in a fixed orifice or capillary tube system, systems with TXVs are less affected by undercharging.

The Department found that certain commercial unitary air-cooled air conditioners and air-source heat pumps already incorporate thermal expansion valves. The Department understands that expansion valve technology is a feature that can improve annual energy performance. However, because the EPCA energy descriptor for commercial unitary air-cooled air conditioners and air-source heat pumps is in terms of EER, TXVs as a design option are not viable for consideration in the engineering analysis.

A.2.4 Electronic Expansion Valves

The use of EXVs, as opposed to fixed orifice type expansion devices, likely has no EER benefit in a properly designed and charged air conditioning system. However, EXVs will typically allow better control of the refrigerant at part-load or at off-design operating conditions. There are other benefits that may result in better field performance as well. Experience with residential air conditioning systems suggests that a large number of the units are improperly charged in the field.

The Department found that certain commercial unitary air-cooled air conditioners and air-source heat pumps already incorporate electronic expansion valves. The Department understands that expansion valve technology is a feature that could improve annual energy performance. However, because the EPCA energy descriptor for commercial unitary air-cooled air conditioners and air-source heat pumps is in terms of EER, EXVs are not a viable design option for consideration in the engineering analysis.

A.2.5 High-Pressure-Side Solenoid Valve and Discharge Line Check-Valve

High-pressure-side solenoid and discharge line check-valves minimize pressure equalization in air conditioning systems. When the compressor of a typical air conditioning system shuts off, the refrigerant tends to migrate from the high-pressure side to the low-pressure side until the entire system reaches equilibrium. This results in some energy loss in the system, but this is arguably more important in a residential system than a commercial system. In a residential system, the off-cycle leakage of refrigerant through the expansion device may occur after the supply fan shuts off and provides little or no cooling to the space. In a commercial system, the supply fan will typically run continuously and leakage through the expansion device provides additional cooling to the space. The savings in most commercial applications are typically small and may not outweigh the efficiency penalty of the additional refrigerant line restrictions for the added valves.

The Department found that certain commercial unitary air-cooled air conditioners and air-source heat pumps already incorporate high-pressure-side solenoid and discharge line check-valves to minimize pressure equalization in the system. The Department understands that such pressure equalization check valves are a feature that can improve annual energy performance. However, because the EPCA energy descriptor for commercial unitary air-cooled air conditioners and air-source heat pumps is in terms of EER, such valves are not viable design options for consideration in the engineering analysis.

A.2.6 Double-Skin and High-Albedo Cabinets

Double-skin cabinets contain more physically protected, insulating material to minimize heat exchange between the air conditioning equipment and the outdoor environment. High-albedo cabinets are finished in white or other light colors to reflect solar radiation from the air conditioning equipment. Use of either can result in some reduction of ambient heat gain to a commercial unitary air conditioning system and thus increase the net efficiency of the system. However, current Air-Conditioning and Refrigeration Institute (ARI) rating procedures cannot quantify this increase in efficiency.

The Department found that certain commercial unitary air conditioner and heat pump designs already minimize heat exchange through better protective insulation and coatings. The Department understands that better protective insulation and coatings are features that can improve annual energy performance. However, because the EPCA energy descriptor for commercial unitary air-cooled air conditioners and air-source heat pumps is in terms of EER, these design options are not viable for consideration in the engineering analysis.

A.2.7 Demand-Controlled Ventilation Strategy

A DCV strategy is a method of controlling the amount of outside air supplied by a heating, ventilating and air conditioning system to a zone within a building by monitoring a particular parameter. The most common parameter of interest is carbon dioxide (CO_2) because it is given off during human respiration and acts as an occupancy-level indicator. If the CO_2 level in a building space is below a preset design measurement, it indicates that fewer people are present in the space and the amount of ventilation air supplied by the air handling system to that space may safely be decreased below the design ventilation level. The appeal of controlling ventilation to meet CO_2 levels comes primarily from the ability to achieve energy savings, while maintaining the quality of the indoor environment. One concern with the use of CO_2 as a control parameter is the possibility of health-related liabilities to the manufacturer and contractor.[2] However, ASHRAE Standard 62, "Ventilation for Acceptable Indoor Air Quality," is the most commonly cited standard for ventilation and provides guidance for demand-controlled ventilation strategies in its last three published versions (62-1989, 62.1-1999, and 62.1-2001).[3]

The Department found that certain commercial unitary air-cooled air conditioners and air-source heat pumps use demand-controlled ventilation devices. Notwithstanding the aforementioned concern for indoor air quality, the Department understands that the guidance provided by ASHRAE Standard 62 would eliminate any potentially adverse impacts on health and safety to consumers. Also, the Department understands that a demand-controlled ventilation device is a feature that can improve annual energy performance. However, because the EPCA energy descriptor for commercial unitary air-cooled air conditioners and air-source heat pumps is in terms of EER, it is not viable for consideration as a design option for improving commercial unitary air conditioning equipment efficiency in the engineering analysis.

A.2.8 Economizer

An economizer consists of motorized dampers that operate together to blend outside and return air to take advantage of cool and dry outdoor air. An economizer may supplement mechanical cooling or, in some cases where the outside air is sufficiently cool, provide the total required cooling. A building with relatively high internal heating loads, located in geographical areas with many heating degree days, is ideal for the application of economizers. This device has the benefit of substantially reducing the cooling load seen by the compressor and thus decreasing the compressor energy requirements. Typically, however, economizer benefits occur under off-design conditions.

The Department found that certain commercial unitary air-cooled air conditioners and air-source heat pumps use economizers. The Department understands that an economizer is a feature that can improve annual energy performance. However, an economizer device that operates under reduced outside air temperature instead of at full-load steady-state conditions would not improve EER. Therefore, DOE will not consider this technology to improve the efficiency of the commercial unitary air conditioning equipment in the engineering analysis.

A.2.9 Thermal Energy Storage

TES systems cool a storage medium and then use that cold medium to cool supply air at a later point in time. Using thermal storage can potentially reduce the size and initial cost of cooling systems and can lower energy costs by shifting compressor energy use to off-peak electrical rates. It is noteworthy that because of storage losses and parasitic energy use, TES systems often increase energy consumption while reducing net energy cost. Generally, TES systems are not associated with commercial unitary air conditioning systems because the added size, cost, and complexity of a thermal energy storage system outweigh the economic benefits.

The Department found that certain commercial unitary air-cooled air conditioners and air-source heat pumps use thermal energy storage systems. The Department understands that a thermal energy storage system is a feature that can improve annual energy performance. However, because the EPCA energy descriptor for commercial unitary air-cooled air conditioners and air-source heat pumps is in terms of EER, which is a steady-state metric for full-load efficiency, the test procedure cannot take into account a technology that stores energy for later use. Therefore, DOE will not consider this technology for improving the efficiency of the commercial unitary air conditioning equipment in the engineering analysis.

A.2.10 Multiple-Speed Supply Fans

A single-speed supply fan is the norm in commercial unitary air conditioning equipment at the ASHRAE/IESNA Standard 90.1-1999 efficiency levels in all capacities covered by this rulemaking. However, because the peak design cooling load requirements dictate system air volume, it is possible to use multiple-speed or variable-speed supply fans to reduce the fan air volume and fan energy use during other than peak cooling design conditions. Considerations for reduction of load include being able to match the air volume to the heating and cooling energy use, as well as maintaining ventilation and air change rates at acceptable levels.

The Department found that certain commercial unitary air-cooled air conditioners and air-source heat pumps use a multiple-speed supply fan. The Department understands that a multiple-speed supply fan is a feature that can improve annual energy performance. However, because the EPCA energy descriptor for commercial unitary air-cooled air conditioners and air-source heat pumps is in terms of EER that is measured at full-load and steady-state operation, and the test procedure does not take into account such multiple speed devices for part-load operation, a multiple-speed supply fan does not improve the EER. Therefore, DOE will not consider this technology further.

A.2.11 Multiple-Speed Condenser Fans

Condenser fan systems composed of multiple fans are the norm in commercial unitary equipment at the ASHRAE/IESNA Standard 90.1-1999 efficiency levels in all capacities covered by this rulemaking. This is a result of lower costs/Btu of fan capacity for smaller fans as a result principally of larger sales volumes and their widespread use in residential size equipment. The use of multiple fans may also allow for some control of the fan power and condenser heat exchange rates during part-load or low temperature cooling operation. However, similar levels of control are achieved with larger, multiple-speed fans in which better motor efficiency as well as more efficient fan designs may be available.

The Department found that the majority of the commercial HVAC equipment already incorporate multiple-speed condenser fans. The Department also understands that a multiple-speed condenser fan is a feature that can improve annual energy performance. However, because the EPCA energy descriptor for commercial unitary air-cooled air conditioners and air-source heat pumps is in terms of EER that is measured at full-load and steady-state operation, and the test procedure does not take into account such multiple-speed devices for part-load operation, a multiple-speed condenser fan does not improve EER. Consequently, multiple-speed condenser fans are not viable for consideration in the engineering analysis.

A.3 COMMERCIAL TECHNOLOGIES THAT TYPICALLY DEGRADE EER, BUT CAN REDUCE ANNUAL ENERGY USE

These are technologies that can improve the net annual energy performance of a system but which generally reduce the performance at full load compared to a similar system not incorporating the technology. An example of this is the use of an inverter speed control on the supply fan. There would be an energy penalty because of the inefficiency of the inverter at peak cooling design conditions, but the continuous ability to match supply fan air flow to the building's cooling and ventilation requirements would more than make up for the loss in efficiency. This provides a significant potential to improve annual energy performance, but at the cost of reduced EER rating conditions. Technologies within this category are:

- Inverter-Driven, Variable-Speed Compressors,
- Inverter-Driven, Variable-Speed Indoor or Condenser Fans, and
- Exhaust Air Enthalpy Recovery.

A.3.1 Inverter-Driven, Variable-Speed Compressors

Inverter-driven, variable-speed compressors provide for more closely matching the capacity of the equipment with the load, and thus remove cycling issues while at the same time increasing the ratio of heat exchanger capacity to compressor capacity during those periods. The benefit at part load is to provide for continuous capacity variation, in contrast to the discrete stages of capacity variation achieved with the use of multiple or staged compressors. Currently, commercial unitary air conditioning equipment does not typically use these technologies to meet the ASHRAE/IESNA Standard 90.1-1999 efficiency levels, primarily because the benefits they offer at part-load do not exceed the perceived first-cost and peak-load impacts. Performance of inverter-driven compressors typically suffers under full-load operating conditions as a result of losses inherent in the electronic frequency conversion. Also, because the addition of the inverter drive adds new energy requirements to the system without providing benefit at full-load, a decrease in rated EER may result. However, if costs and energy losses become low enough, inverter-driven, variable-speed compressors could become a viable competitor to other unloading and staging technologies.

The Department found that certain commercial unitary air-cooled air conditioners and air-source heat pumps use an inverter-driven, variable-speed compressor. The Department understands that an inverter-driven, variable-speed compressor is a feature that can improve annual energy performance. However, because the EPCA energy descriptor for commercial unitary air-cooled air conditioners and air-source heat pumps is in terms of EER that is measured at full-load and steady-state operation, and the test procedure does not take into account operation and improved performance under part-load conditions, these compressors do not improve EER. Therefore, this technology is not viable for consideration in the engineering analysis.

A.3.2 Inverter-Driven, Variable-Speed Indoor or Condenser Fans

As with compressors, inverter-driven fans enable adjustments to the supply or condenser air volume to optimally meet the building cooling load while minimizing annual energy use. However, because of the energy losses inherent in the inverter, implementation of this technology could actually reduce the rated EER.

The Department found that certain commercial unitary air-cooled air conditioners and air-source heat pumps use inverter-driven, variable-speed indoor or condenser fans. The Department understands that an inverter-driven, variable-speed indoor or condenser fan is a feature that can improve annual energy performance. However, because the EPCA energy descriptor for commercial unitary air-cooled air conditioners and air-source heat pumps is in terms of EER that is measured at full-load and steady-state operation, and the test procedure does not take into account such multiple-speed devices for part-load operation, these fans do not improve EER. Therefore, this technology is not viable for consideration in the engineering analysis.

A.3.3 Exhaust Air Enthalpy Recovery

Exhaust (heated) air enthalpy recovery (using desiccant materials) has the potential for significant energy savings in reducing the energy needed to condition ventilation air. The most common way of incorporating enthalpy recovery is to use a wheel-shaped, honey-combed matrix impregnated with solid desiccant. With this enthalpy wheel, supply air passes through one sector of the wheel (half the area of the circle) where the desiccant absorbs moisture from the air. The wheel then rotates at slow speed into the exhaust air-stream. The exhaust air (now reactivation air) absorbs the water from the desiccant as it exits the building. This process is energy efficient because it removes both heat and humidity from the supply air at less cost than the refrigeration cycle.[4] The principal operating cost penalty for the system is the fan energy that pushes ventilation and exhaust air through the enthalpy wheel matrix. Several major air conditioning manufacturers sell optional enthalpy recovery sections for use with commercial unitary air conditioning equipment. The greatest benefit of the enthalpy recovery occurs under peak cooling and heating conditions. Some benefit exists whenever there is a ventilation cooling or heating load in the building such that the savings in compressor or heating fuel energy use offset the operating energy penalty for the enthalpy recovery device. It is important to point out that savings from this technology arise mainly from both climate considerations and ventilation loads. For geographical locations with mild climates, enthalpy recovery might not produce energy savings. Also the additional fan energy penalty of the heat exchange section will likely reduce the EER rating of the equipment.

The Department found that certain commercial unitary air-cooled air conditioners and air-source heat pumps use enthalpy recovery systems to remove heat, humidity or both from the air.

The Department understands that these energy recovery systems are an added feature that can improve annual energy performance of air conditioning equipment. However, because the EPCA energy descriptor for commercial unitary air-cooled air conditioners and air-source heat pumps is in terms of EER, and the test procedure does not explicitly take into account ventilation rates or exhaust rates needed to assess the energy improvements with exhaust air enthalpy recovery, this technology does not improve EER. Therefore, exhaust air enthalpy recovery systems are not viable for consideration in the engineering analysis.

A.4 ENABLING TECHNOLOGIES

Enabling technologies are those technologies that may help meet system design requirements, such as system sensible heat ratio, but cannot by themselves improve energy efficiency under the design test conditions. In general, enabling technologies appear to have a negative impact on EER when used alone. An example of this is the wrap-around heat pipe. This technology provides a method to reheat supply air by transferring heat from the air that enters the cooling coil to the air that leaves the cooling coil. This increases the dehumidification capability of the system without overcooling the supply air. The DOE discusses one such enabling technology below.

A.4.1 Wrap-Around Heat-Pipes (For High Latent Loads)

To make a room comfortable in a hot, humid climate, an air conditioner must lower the indoor air temperature and humidity. If an air conditioner fails to adequately lower the humidity, the air will feel cool but uncomfortably damp. Dehumidification is largely a function of maintaining cool evaporator coil temperatures during air conditioner operation. One typical method of achieving higher energy efficiency is to increase the volume of supply air across the evaporator coil, which increases the average coil temperature, although it may reduce the dehumidification capability of the coil. One technology that addresses this problem is the wrap-around heat pipe.

A wrap-around heat-pipe resembles two heat exchangers located on either side of an air conditioner's evaporator coil. Several tubes connect the two heat exchange sections. A liquid refrigerant inside the tubes pre-cools the incoming supply air by absorbing heat from it. This causes the refrigerant in the tube to evaporate. The air conditioner evaporator coil further cools the precooled air, extracting up to 91 percent more water vapor than a conventional evaporator. After the liquid refrigerant in the tubes changes to a vapor, it flows to the condensing part of the heat-pipe heat exchanger, located downstream of the main cooling coil. There, the refrigerant condenses back into a liquid as it releases heat into the air stream, thus warming the cold supply air. The refrigerant then flows by gravity to the evaporator side of the heat pipe to begin the cycle again.[5] This continuous pre-cooling of air entering the evaporator coil and later reheating the air after the evaporator coil, increases dehumidification at the expense of some additional fan energy.

The Department found that certain commercial unitary air-cooled air conditioners and air-source heat pumps use wrap-around heat-pipes. However, the Department understands that this technology has limited ability to supply air at desired temperature and humidity levels efficiently. Furthermore, the EPCA energy descriptor for commercial unitary air-cooled air conditioners and air-source heat pumps is in terms of EER that is measured at full-load and steady-state operation. The test procedure does not take into account the variability of climatic conditions, such as regions with high humidity which could benefit from this design option, or regions with low humidity where this design option might not make sense. Consequently, this design option is not suitable for across-the-board applications in commercial unitary air-cooled air conditioners and air-source heat pumps. Therefore, wrap-around heat-pipes are not viable for consideration in the engineering analysis.

A.5 SUMMARY

Table A.5.1 summarizes the technologies that are not being considered for the engineering analysis.

Table A.5.1 Design Options Not Viable for Consideration in the Engineering Analysis

COMMERCIAL TECHNOLOGIES THAT DO NOT IMPACT EER, **BUT REDUCE ANNUAL ENERGY USE**
Certain commercial unitary air-cooled air conditioners and air-source heat pumps already incorporate one or more of the following eight design options to improve annual energy performance under part-load conditions, although these design options do not impact EER. (1) *Multiple Compressors* (2) *Compressor Cylinder Staging* (3) *Thermal Expansion Valves (TXV)* (4) *Electronic Expansion Valves (EXV)* (5) *High-Pressure-Side Solenoid Valve and Discharge Line Check-Valve to Minimize Pressure Equalization* (6) *Double-Skin, High-Albedo Cabinets* (7) *Multiple-Speed Supply Fans* (8) *Multiple-Speed Condenser Fans*

Table A.5.1 Design Options Not Viable for Consideration in the Engineering Analysis (continued)

COMMERCIAL TECHNOLOGIES THAT DO NOT IMPACT EER, BUT REDUCE ANNUAL ENERGY USE (continued)
The following three design options are useful with certain commercial unitary air-cooled air conditioners and air-source heat pumps because they improve annual energy performance under part-load conditions, although they do not impact EER. (1) <u>*Demand-Controlled Ventilation (DCV) Strategy*</u> — This design option improves annual energy use by enabling control of building ventilation under full- and part-load conditions. However, the EPCA energy descriptor is in terms of EER and the test procedure does not take into account part-load conditions or building ventilation load. (2) <u>*Economizer*</u> — This design option supplements mechanical cooling in buildings with high internal heating loads by blending outside and return air to take advantage of cool and dry outdoor air. Typically, economizer benefits occur under off-design conditions. However, the EPCA energy descriptor is in terms of EER and the test procedure does not take into account a device that operates under reduced outside air temperature instead of full-load steady-state conditions. (3) <u>*Thermal Energy Storage*</u> — This design option stores energy for later use. The EPCA energy descriptor for commercial unitary air-cooled air conditioners and air-source heat pumps is in terms of EER, and the test procedure does not take into account a technology that stores energy for later use.

Table A.5.1 Design Options Not Viable for Consideration in the Engineering Analysis (continued)

COMMERCIAL TECHNOLOGIES THAT TYPICALLY DEGRADE EER, BUT CAN REDUCE ANNUAL ENERGY USE
The following three design options are useful with certain commercial unitary air-cooled air conditioners and air-source heat pumps because they can improve annual energy performance under part-load conditions, although they typically degrade EER. (1) *Inverter-Driven, Variable-Speed Compressors* — This design option enables matching the capacity of the air conditioning equipment with the load, and under part-load conditions it provides continuous capacity variation, thus reducing annual energy use. However, because this design option operates with an inverter drive that uses energy while providing no full-load benefit, it can degrade EER performance. (2) *Inverter-Driven, Variable-Speed Indoor or Condenser Fans* — This design option adjusts supply or condenser air volumes to optimally meet building cooling loads while reducing annual energy use. However, because this design option operates with an inverter that uses energy while providing no full-load benefit, it can degrade EER performance. (3) *Exhaust Air Enthalpy Recovery* — This design option removes both heat and humidity from the supply air. Its greatest benefit occurs under peak cooling or heating conditions, and there is some benefit whenever there is a ventilation load in a building. Energy savings arise from climatic considerations and ventilation loads. Mild climates and part-load or ventilation-only conditions do not offer energy savings. Also, because an exhaust air enthalpy recovery system operates with a fan that uses energy, it is likely to reduce the EER rating of the air conditioning equipment.
ENABLING TECHNOLOGIES
Wrap-Around Heat-Pipes (For High Latent Loads) — This design option removes humidity from the supply air at the expense of using some additional fan energy. Its greatest benefit occurs in climates with high humidity, but would not make sense in climates with low humidity. This design option is not suitable for across-the-board application. The test procedure for EER does not take into account the variability of climatic conditions, such as regions of high humidity, which could benefit from this design option, or regions with low humidity, where this design option might not make sense.

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